Volume and Productivity of the Hungarian Inpatient Health Care

Antónia Hüttl
research advisor
Kopint-Tárki Institute for Economic Research Co.
E-mail: antonia.huttl@kopint-tarki.hu

Ágnes Nagy
senior research associate
Kopint-Tárki Institute for Economic Research Co.
E-mail: agnes.nagy@kopint-tarki.hu

The present case study, after a short outline of the methodology on measuring non-market services, investigates how output and productivity of inpatient health services could be measured in Hungary based on available – mainly administrative – data.[1]

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National accounts.
Non-market services.
Health statistics.

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The valuation of non-market services is not as straightforward as that of market services which are valued at market prices. In a state of market equilibrium, market price relatives reflect the optimal composition of producers' supply and consumers' demand. The former is called output of production, while the latter is an outcome that indicates the revealed preferences of consumers. Therefore, market prices are able to evaluate both the output and outcome of market services.

Productivity is the ratio of output to different types of inputs (e.g. resources required to produce goods and services). For instance, labour productivity is the output per capita of the labour denominated in full-time equivalent. Aggregated multifactor inputs (labour, capital, etc.) can be expressed in monetary units and not in physical units. According to the mainstream economic theory, the marginal output equals marginal inputs, so the level of multifactor productivity is always one. What could be measured is the change of multifactor productivity in time i.e. the change in the output volume compared to that in input volumes. When elementary output and input data are aggregated, the price relatives are used as weights.

As non-market services are provided free of charge or for nominal fees, there is no way to use the market price to value the output. Instead, the output is measured by the costs of production. This measurement, however, underestimates the value of non-market services because it does not take account of the normal profit e.g. the opportunity costs of capital. Nevertheless, the measurement of productivity is even more problematic. As the output is valued by the sum of inputs, it makes no sense to relate changes in output to those in inputs.

The only solution for determining the productivity of non-market services is to measure the output volume (e.g. service quantity and quality) changes directly. In the case of non-market services provided individually, data expressed in physical units, indicating quantity changes could be collected. They should be as detailed as possible by types of services so the changes in the service mix might be accounted properly as volume change. When elementary quantity indices are aggregated, the relative costs are used as weights.

More consideration is needed before searching for data on quality changes. In measuring productivity, both input and output quality changes should be considered as volume changes. If inputs are traded on the market, market prices reflect qualities. Therefore, if price representatives are selected carefully and volume changes are estimated through deflation, then quality changes are determined properly. As regards labour input, when it is measured directly by the number of workers (in full-time equivalent), it is necessary to adjust the changes in volume by those in working skills.

Determining the quality changes of the output of non-market services is more problematic. We have two options for that: measuring directly the service provision itself (technological improvements, new types of services introduced, etc.) or measuring the outcome e.g. the improvements in the status of the recipients of such services due to the service consumed.

The first approach requires expertise in the provision, technology and procedures of services. Although some case studies provide information on advances in certain services, their findings are difficult to generalize. Indeed, if the outcome is measured directly, satisfaction surveys may present subjective opinions influenced by factors that are only loosely related to the quality of services consumed.

Concerning health care services, the Eurostat Handbook on Price and Volume Measures in National Accounts (*Eurostat* [2001] p. 117.) says: "For volume measurement the focus is on outputs not on the final outcomes as measured, for example, by summary indicators like gains on Quality Adjusted Life Years attributable to a specific treatment. However, information on specific aspects of outcomes might serve as proxies for changes in the quality of the service output."

1. Data sources

Concerning output of inpatient care, available data sources coming mainly from administrative files are used for estimates. The reports submitted by the service providers to National Health Insurance Fund (NHIF) are serving as a source to measure the volume index of output.

For measuring labour and capital inputs, the estimates rely on fairly aggregated statistical sources coming mainly from national accounts.

1.1. Data on outputs

The product classification contains cc. 700 diagnosis-related groups (DRGs) that are modified from time to time.

The episodes – combining the diagnosis (based on the International Classification of Diseases-10) and the treatments / activities – are classified in DRGs by a special software. A handbook of about 1200 pages defines the rules for classifying the reports by DRGs.

The DRG system was introduced in the Hungarian hospital sector in 1993 and since then it has been revised regularly.

The content of the reports has been modified several times, but all relevant data are documented and accessible. One case (episode) is a set of activities (treatments) a patient receives in one department of an inpatient institution. In principle, these data sources may provide an opportunity to identify the continuous spells as complete sequences of treatments received by individuals with the same diagnosis. This could be the ideal unit of output. However, at present, NHIF does not make such data processing.

Data on exceptional cases (e.g. organ transplantations) are not included in the database. The financing of such cases requires special authorisation. (They account for less than 1% of all cases, but their costs amount to 7-8% of the total inpatient financing.)

The DRG points that indicate the shares of the episodes in financing are regulated by government decrees. In principle, these points correspond to the unit cost, the average current cost of the set of activities the patient should get as part of the episode. The costs of depreciation are not covered except in cases when the services are provided mainly by private providers (e.g. renal dialysis).[2] In practice, the points are not fixed and they may vary during a year. For example, they are decreased proportionally, if more cases are treated (e.g. in a month) than it was planned.

During the 2004–2009 period, there was also another financing constraint: the maximum number of cases financed by the NHIF was limited for each provider. (The so-called performance volume limit was introduced in 2004.) If more cases are reported than the largest number allowed, then the over-the-limit cases are not financed at all. (At first, cases above the cap were financed according to a declining scale.) It implies that the average price decreases. The data used in the research represent the annual average costs of DRGs financed by NHIF.

The services provided in rehabilitation and chronic departments are financed by the length of stay in the institution. About 3-9 types of cases are distinguished, depending on how serious they are. The classification also varies from time to time.

1.2. Data on inputs

In the measurement of labour and capital inputs, the estimates rely on fairly aggregated statistical sources coming mainly from the national accounts.

[2] The actual costs by episodes are not reported regularly. Occasionally, some surveys are conducted to inquire about these costs, the results of which are used to revise the points/weights of DRGs. The last survey was carried out in November 2008 (the previous one in 1998) when twenty-seven hospitals reported during 20 weeks on the costs of about 600-700 thousand episodes, the cases of 100-120 thousand patients.

For labour input, a special data collection on employment and wages, managed by the Ministry of Health is used as the primary data source. The published data covers the period 2003 to 2009. The dataset keeps record on the total number of the healthcare workers. The number of hours worked is not recorded, so full-time equivalent figures could not be calculated. Three categories of the employed are distinguished: medical doctors, other medical professionals and auxiliary workers. For these three categories, monthly wages are also recorded.

The capital input estimates are from the national accounts that provide estimates on the net value of stocks of fixed assets and on depreciation by the PIM (perpetual inventory method) at two-digit level industrial classification. Health care and social work (Division 85 NACE Rev. 1.) are recorded together. Investment surveys are organised at institutional level, providing an opportunity to estimate the share of inpatient care (Class 85.11 NACE Rev. 1.) in the total health and social work as for the value of newly invested fixed assets. We used this percentage to estimate the share of the net fixed assets of inpatient care in the total stock of fixed assets in health care and social work. Different shares were applied for different types of assets (other buildings and structures, machinery and equipment, transport and intangible assets/software), using the average shares coming from an investment survey for the years 2005–2009. In this period, 54% of all investments in health and social work were made in inpatient care. The figures indicate that the composition of investments in inpatient health care differs significantly from that in the whole division of health care and social work. For example, the share of machinery and equipment is 64% in inpatient health care that is 10 percentage points higher than the average. The aforementioned shares were applied to allocate the value of the stocks of net fixed assets to inpatient care.

2. Volume indices of inpatient health care

As already mentioned, a complete sequence of treatments would be the ideal unit of the output of health care provision. At present, the available data allow to distinguish only episodes, treatments received in one single department of a hospital. If a patient is transferred from one institution to another or from one department to another within the same hospital, it is treated as two different cases even if his/her treatment is continuous. Thus, changes in the institutional structure of health service provision may distort the number of cases recorded, and similarly, the reorganisation of the patients' pathway, e.g. directing patients during the treatment from one inpatient department to another is recorded as an additional case.

2.1. Volume indices of acute inpatient care

The volume index of acute inpatient care is composed in three steps. First, elementary indices of DRGs are estimated, then a cost weighted composite index is calculated, finally the index is modified by measuring changes in quality.

2.1.1. Estimating elementary quantity indices

The episodes are classified by DRGs. An elementary quantity index indicates the – non-weighted – average of the annual changes in the number of individual episodes.

If the output volume index is estimated directly, not through deflation, then it should cover the total population of cases. However, a sample does not suffice, because the number of individual DRGs may change in a hectic way.

In several cases, the number of DRGs cannot be compared directly between years, because the classification is revised from time to time. Changes may occur in the content of DRGs without or with code modifications (new groups are created, the existing ones are eliminated). The first case cannot be corrected, as it is not known to what extent the modification of the DRG content affects the quality of service (e.g. a supplementary procedure is added). On the contrary, code modifications can be adjusted, for instance, by splitting up or aggregating DRGs. For estimations, we have used the instructions and explanations the NHIF sent to the hospitals together with the new codes. To calculate elementary chain quantity indices, the minimum requirement is to harmonise the classification of two subsequent years. Thus, when Laspeyres indices were compiled, a given year's classification was adjusted to that of the previous year.

As a result, two columns are available in the database for each year (t): one with the original data received from NHIF and one with data comparable to year $t-1$.

Table 1 shows that between 2001 and 2009 significant changes occurred in the number of episodes. Not as much the total number of episodes (the care provided to one patient in one inpatient department) fluctuated, but rather their number increased moderately in every year except for the period 2005–2007 when a major reorganisation has shifted cases treated previously in acute inpatient departments either to outpatient care or to rehabilitation and long-term departments. The average elementary indices increased much quicker than the total number of episodes, which implies a radical shift in the DRG composition of services. This makes the weighted /composite volume index sensitive to the choice of weights.

Table 1

Average elementary quantity indices of acute inpatient health care
(previous year = 1)

Year	Change in the total number of episodes	Average elementary index of episodes	Standard deviation
2009/2008	1.004	1.3712	6.5045
2008/2007	1.013	1.1214	0.9994
2007/2006	0.866	0.8803	0.4666
2006/2005	0.973	1.5630	5.9552
2005/2004	1.014	1.1277	1.0011
2004/2003	1.006	1.3137	2.1480
2003/2002	1.037	1.0758	0.4065
2002/2001	1.016	1.5982	7.3852

Source: Here and in Tables 2–5, 7–10 and in Figure 1, estimations based on NHIF data.

2.1.2. Estimating quality unadjusted composite quantity indices

A change in the – quality unadjusted – volume of inpatient healthcare provision is measured by the composite volume index of episodes classified by DRGs. In principle, various social values are attached to different DRGs, and these values provide the weights for aggregation. In the case of market production, for example, the percentage of the total income that is spent by consumers on the purchase of products is used as a weight. In non-market production, cost shares substitute income shares. However, in Hungary, data on actual total costs by DRGs are not collected regularly. Only a part of these costs reimbursed by NHIF is known.

The depreciation of fixed assets is not included in the amounts financed by NHIF. Replacement of assets and gross fixed capital formation are to be financed by the owners of health care institutions.

Hospitals provide a wide range of services, and, as a rule, the amount they receive from NHIF should cover their total costs (without capital costs) at institutional level. It is not a strict rule, however, that individual DRGs should be financed proportionally to actual costs shares. Nevertheless, the cost share financed by the government (through NHIF) can be considered as some kind of social valuation. It is important to stress that owing to the high dispersion of elementary indices, the weighting system affects substantially the composite index value.

Table 2

Quality unadjusted composite volume indices of acute inpatient health care
(previous year = 1)

Year	Composite quantity index	Standard deviation
2009/2008	0.9998	0.2765
2008/2007	1.0292	0.2684
2007/2006	0.8926	0.2640
2006/2005	0.9834	1.3916
2005/2004	1.0408	0.2516
2004/2003	1.0104	0.4839
2003/2002	1.0793	0.1816
2002/2001	1.0734	0.5240

2.1.3. Quality adjustments

As already mentioned, non-market production volume indices should be measured in a constructive way, not by price indices through deflation. To do so, one should identify criteria characterising the quality of services and its changes in time. The literature distinguishes two main types of quality dimensions in health care (*Kelley–Hurst* [2006], *Arah et al*. [2006], *Gaál et al*. [2012]): *1*. clinical quality for treatment effectiveness and safety; and *2*. service quality indicating responsiveness in the patient-in-the-centre type of services.

The INDICSER project makes use of such quality criteria for which data are available at the level of individual DRGs. This way the changes in the composition of services and their effect on the quality are also recorded. (Improving the quality of a more expensive health procedure counts more than that of a less expensive one.)

In acute inpatient care – relying on the available data at the level of individual DRGs – four kinds of quality dimensions could be considered: changes in the *1*. hospital mortality rates; *2*. average length of hospital stay; *3*. number of patients with nosocomial infections; and *4*. age of patients.

The first two dimensions reflect clinical quality, whereas the rate of nosocomial infections and the age of patients indicate the patient-centeredness of services. In the following, we discuss the way of adjusting by these four criteria the quality changes of acute inpatient care.

In fact, it is not obvious how the quality of health care provision is influenced by these characteristics. Neither the numerical measurement of their effects is clear nor does it be evident whether the sign of these effects is positive or negative. For instance, when the average length of hospital stay declines, it may be interpreted as a negative

effect if we assume that the reduction is caused merely by cost saving initiated either by the hospital or by the government. A cheaper service may indicate lower quality. It may happen that the length of stay in acute care is reduced and patients are transferred to rehabilitation departments, what should be considered as a quality decline of acute care (and a volume increase of rehabilitation care). However, if we assume that shorter stays in hospitals are due to technological improvements that enable the finding of diagnosis earlier, the application of less complicated procedures, etc., then the shorter length of hospital stay implies a higher quality service for patients. As *Dózsa–Kövi–Ecseki* [2010] formulates "the average length of hospital stay is one of the best indicators of technical efficiency." It is widely accepted that technical (clinical) efficiency is closely related to quality (or to costs saving).

Changes in the hospital mortality rates. If quality of health services is measured by the outcome appreciated by patients, then higher hospital mortality rates have an opposite effect. When somebody does not survive, he or she does not experience "consumer utility". Therefore, such cases should not be accounted as output, assuming that without treatment, the patient would not have survived either. (It is disregarded that the death may happen despite careful treatment.) Following this train of thought, we have multiplied the unadjusted volume indices by the hospital survival rate.

Table 3

Changes of the hospital survival rate in acute inpatient care
(previous year = 1)

Year	Average index of survival rate	Composite, adjusted quantity index
2009/2008	0.9998	1.0013
2008/2007	0.9962	1.0272
2007/2006	1.0025	0,8926
2006/2005	1.0009	0.9840
2005/2004	1.0029	1.0424
2004/2003	1.0023	1.0140
2003/2002	1.0003	1.0807
2002/2001	1.0017	1.0752

Note. At elementary DRG level, the adjusted quantity index is the product of the unadjusted quantity index and the index of the survival rate. However, because of weighting, this relation may not be true at composite level.

The technological advances enabling the treatment of elder patients that was previously not possible, may contribute to the higher mortality rate. This effect should be counterbalanced when estimating the loss of utility due to death.

Changes in the average length of hospital stay. As already mentioned, various factors may cause changes in the length of hospital stay. We assume that the technological development is a determinant among them. In other words, the past decade's technological development taken place in health services is evidenced by the shortening of time the patients have to spend in hospitals. Several health care specialists share this view (see *Dózsa–Kövi–Ecseki* [2010]), emphasizing that the length of hospital stay is one of the best indicators demonstrating the technological development of the Hungarian health care. All other factors – particularly the organisational changes occurred in the patient path – influencing the average length of hospital stay are disregarded.

Two versions have been calculated. The first reckons only with the shortening of the length of hospital stay and assumes that it improves quality. Thus, if a patient stays longer in the hospital, it means he suffers from a more complicated disease, and not the quality of the service deteriorates. In the second version, changes in the length of stay are accounted in both directions; they refer to either improvement or decline in the quality of the health service rendered.

The quality effect of the changes in the length of hospital stay has been estimated by the following function:

$$\text{Quality change} = e^{0.15 * (1-\text{proportional change in the average length of stays})},$$

where 0.15 comes from the assumption that shortening of the length of hospital stay by 10% causes about 1.5% improvement in quality. Interviews with health experts may help in quantifying more accurately this parameter.

Table 4

Quality effects of the changes in the average length of hospital stay in acute inpatient care
(previous year = 1)

Year	Shorter and longer stay	Shorter stay
2009/2008	1.0024	1.0106
2008/2007	0.9997	1.0065
2007/2006	1.0115	1.0180
2006/2005	1.0067	1.0129
2005/2004	1.0043	1.0066
2004/2003	1.0109	1.0159
2003/2002	1.0067	1.0094
2002/2001	1.0046	1.0109

Changes in the occurrence of nosocomial infections. We have examined the option to consider the changes in the number of patients with nosocomial infections as a quality dimension, although, the occurrence of such infections is not significant (they amount to about 0.1% of all cases). Nevertheless, one may have reservations concerning the reliability of the reported numbers. These figures are not important in terms of financing, so their reporting is not controlled by NHIF. For these reasons, the indices of nosocomial infections have been disregarded.

Table 5

The occurrence and changes in the number of nosocomial infections in acute inpatient care

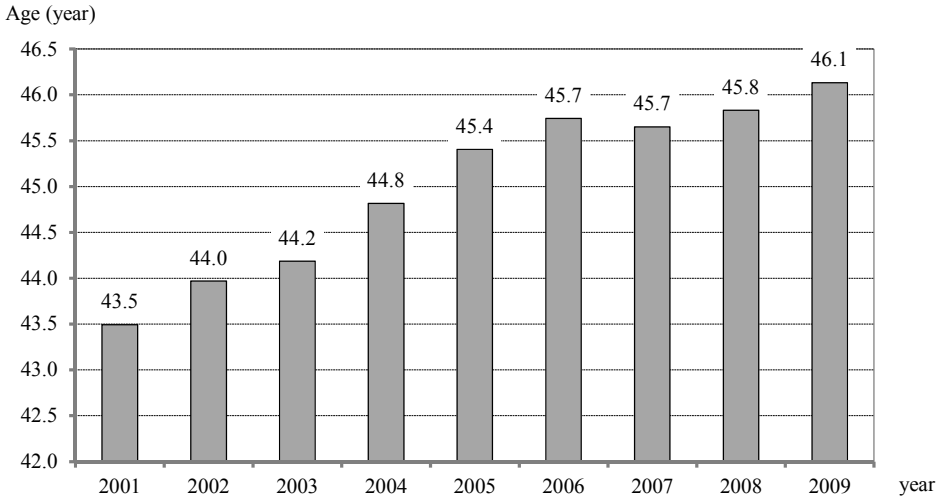
Year	Number of cases	Year	Index of changes (previous year = 1)
2009	2 663	2009/2008	0.9052
2008	2 942	2008/2007	1.0912
2007	2 696	2007/2006	1.1956
2006	2 250	2006/2005	1.1624
2005	1 940	2005/2004	1.0005
2004	1 939	2004/2003	0.9069
2003	2 138	2003/2002	0.9340
2002	2 289	2002/2001	1.2293

Average age of patients in acute inpatient care. Between 2001 and 2009, the total number of patients in acute inpatient health care declined by 6.7%, whereas the number of patients over 70 increased from 488 000 to 516 000. This implies a 2.5-percentage point growth in the share of patients over 70; the average age of patients increased by more than 2.5 years.

It is not evident how the age of patients affects the volume of health service. On the one hand, younger people may enjoy longer the health gain obtained through care. Consumers' utility is not compared interpersonally; likewise, health gain is also measured at individual level without interpersonal comparison.

On the other hand, elder people may suffer from complex diseases with co-morbidities that usually need extra care. Therefore, higher age implies higher volume of health services. The effect of age should also be considered in volume change calculations, at least for those DRG groups (cardiovascular, cataract or intracranial procedures, etc.) where the number of old people has increased significantly. Nevertheless, more research is needed to define a plausible numerical measure indicating this impact.

Figure 1. Average age of patients in acute inpatient care



Output volume index adjusted by two quality criteria. The output volume index of acute inpatient care presented in Table 6 indicates the changes in the number of episodes financed by the NHIF, adjusted by two quality criteria: hospital mortality rate and average length of stay. Both indicators are available regularly.

Table 6

Quality adjusted volume index of acute inpokatient care
(previous year = 1)

Year	Unadjusted composite volume index	Quality adjusted volume index
2009/2008	0.9998	1.0034
2008/2007	1.0292	1.0273
2007/2006	0.8926	0.8983
2006/2005	0.9834	0.9880
2005/2004	1.0408	1.0468
2004/2003	1.0104	1.0162
2003/2002	1.0793	1.0881
2002/2001	1.0734	1.0773

Source: Calculations based on NHIF data.

Surveys and interviews should be conducted at least occasionally to define the size of the effect the length of stay has on health service output. The effect may be differentiated by major DRG groups.

2.1.4. The composition of volume changes in acute care by major groups of diseases

Aggregate figures are indispensable in national accounting, but health experts cannot interpret them easily. The composition of volume changes by major groups of diseases provide more professional explanations on the structural changes occurred in the past period. Without going into profound analysis, the figures presented in Table 7 indicate that the highest volume changes did not occur in cases of vital importance like heart diseases and malignant tumours. Eye diseases and infections are leading the growth rank.

Table 7

Output volume changes by major groups of diseases, 2001–2009

Major group of diseases	Unadjusted volume index	Volume index adjusted by		
		survival rate	the length of stay	both dimensions
	change, 2001 = 1			
Nervous system diseases	1.1390	1.1651	1.1745	1.2016
Eye diseases	1.4101	1.4103	1.5769	1.5771
Ear-nose-throat and maxillofacial diseases	0.7388	0.7392	0.7817	0,7821
Diseases of the respiratory system	0.9798	0.9707	1.0154	1.0059
Cardiovascular diseases	1.0632	1.0671	1.0961	1.0991
Digestive system diseases	0.9129	0.9291	0.9388	0.9553
Hepatic and pancreatic diseases	0.7704	0.7878	0.7885	0.8065
Skeletal musculature and connective tissue diseases	1.0504	1.0554	1.0834	1.0887
Mammary and dermal diseases	0.6667	0.6637	0.6937	0.6907
Endocrine, nutritional and metabolic diseases	1.3405	1.3451	1.3859	1.3907
Renal and urethral diseases	1.1555	1.1548	1.1823	1.1816
Male reproductive system diseases	1.0266	1.0292	1.0908	1.0936
Female reproductive system diseases	0.8365	0.8372	0.8610	0.8618
Pregnancy, delivery, puerperium	1.0069	1.0069	1.0449	1.0449
Neonates	1.1400	1.1725	1.0945	1.1251

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Major group of diseases	Unadjusted volume index	Volume index adjusted by		
		survival rate	the length of stay	both dimensions
	change, 2001 = 1			
Haematic and haematopoietic diseases	1.0891	1.0909	1.1226	1.1246
Myeloproliferatic diseases	1.1603	1.1386	1.1613	1.1405
Infectious diseases	1.8120	1.7924	1.8717	1.8504
Mental diseases	0.8135	0.8135	0.8216	0.8216
Organic, mental diseases caused by alcohol, drugs	0.4881	0.4861	0.4934	0.4914
Injuries, toxaemia	1.4665	1.4673	1.4864	1.4871
Burn, freezing	0.8361	0.8567	0.8505	0.8714
Signs, symptoms	5.1314	5.1691	5.5435	5.5843
AIDS	0.9867	1.0000	1.0224	1.0362
Procedures of polytraumatic status	0.6858	0.6714	0.7060	0.6897
DRG not elsewhere classified	1.7847	1.8249	1.8159	1.8563
Total	1.1003	1.1095	1.1315	1.1408

2.2. Volume indices of inpatient rehabilitation and long-term care

Public care financing in Hungary distinguishes non-acute inpatient care, that is, rehabilitation and long-term hospital care according to about 5-10 classes. The classes differ in the type of services (long-term care, mental or physical rehabilitation, special hospice care, etc.) and in the level of seriousness of the cases. In 2009, the points paid by NHIF for one day of care varied between 1 and 3.6.

During the period 2001–2009, the classification changed several times. In order to calculate quantity indices in sufficient detail, the classification of a given year has been harmonised with that of the previous years. The classes are broad, so changes in the composition of services may bias volume measures. The quality dimensions used for acute care are not relevant in the case of long-term and chronic treatments. Therefore, it is not possible to make any kind of quality adjustment.

As presented in Table 8, the output of inpatient rehabilitation and long-term care increased rapidly by more than 70% between 2001 and 2009. This is partly due to the continuous reorganisation shifting cases – that were previously treated in acute departments – as soon as possible to less costly departments of rehabilitation and of long-term care. Such reorganisation may cause an upward distortion in volume figures because, due to the transfer, the same case is accounted as two distinct episodes.

Table 8

Volume indices of rehabilitation and long-term care
(previous year = 1)

Year	Average of elementary indices	Composite quantity index
2009/2008	1.0420	1.0440
2008/2007	1.1500	1.1630
2007/2006	1.2200	1.0560
2006/2005	0.9900	1.1400
2005/2004	1.0010	1.0010
2004/2003	0.9820	0.9790
2003/2002	1.0330	1.0330
2002/2001	1.1830	1.1740
2009/2001	**1.7386**	**1.7371**

Note. The average of the elementary indices is a non-weighted measure. The composite quantity index is a weighted chain Laspeyres index.

Table 9

Changes in the financing of chronic inpatient health services

Year	Cost financed by NHIF (current value in million HUF)	Year (previous year = 1)	Price index
2009	58 699	2009/2008	0.9926
2008	56 642	2008/2007	1.0449
2007	46 611	2007/2006	1.0565
2006	41 780	2006/2005	0.8933
2005	41 025	2005/2004	1.0765
2004	38 073	2004/2003	1.1158
2003	34 854	2003/2002	1.1898
2002	28 359	2002/2001	0.9379
2001	25 754	**2009/2001**	**1.3121**

If the composite quantity index indicates the changes in the output volume, and the amount paid by the NHIF is known, then the "price index" of rehabilitation and long-term care could be estimated indirectly, dividing current values by volume changes. It is not a genuine price index, since it does not express the price changes of all cost elements used to produce the same volume of chronic health services. It

shows merely the change of expenses that the NHIF pays for the same bundle of chronic health services. In the case of chronic services, the product classification is less detailed than in acute care, so there is less opportunity to attribute the changes in the composition to those in volume.

The figures show a hectic movement in daily finance of chronic care. Rapid and uneven price movements may disturb the calculation of price indices because they usually imply high dispersion of relative prices. Relative prices are important as they provide the weights to aggregation. In health care financing, the points may be used as relative prices. The dispersion of points varies between years (1 is the unit of daily financing of a standard chronic case): in the period 2001–2005 it is around 1.4-1.5, in 2005–2006 1.8-1.9, while in 2008–2009 0.7-0.9, respectively.

2.3. Composite volume index of inpatient care

The composite volume index of inpatient care is the cost-weighted average of acute and chronic inpatient-care volume indices. In spite of the radical shift in favour of chronic care, the composite index is dominated by acute care tendencies, since about 90% of total financing goes to acute care provision.

Table 10

Composite output volume indices of inpatient care

Year	Acute care	Chronic care	Total	Year	Weight of acute care
	previous year = 1				
2009/2008	1.0034	1.0440	1.0090	2008	0.862
2008/2007	1.0273	1.1630	1.0438	2007	0.878
2007/2006	0.8983	1.0560	0.9147	2006	0.897
2006/2005	0.9880	1.1400	1.0038	2005	0.896
2005/2004	1.0468	1.0010	1.0421	2004	0.897
2004/2003	1.0162	0.9790	1.0126	2003	0.904
2003/2002	1.0881	1.0330	1.0826	2002	0.900
2002/2001	1.0773	1.1740	1.0877	2001	0.893
2009/2001	**1.1408**	**1.7371**	**1.2015**		

The cases included in the volume index are treated mostly in government-controlled hospitals and, to a lower extent, in (mainly church-owned) private inpatient care institutions and NGOs that are contracted with NHIF. Inpatient cases financed out of pocket are rare, they occur mostly in plastic surgery and obstetrics.

This means that our estimates might be a good proxy for the total inpatient care of Hungary.

3. Multifactor productivity in inpatient health care

It is widely agreed that in the past decade, a significant productivity progress went on in the Hungarian health care services. However, a comprehensive analysis is not yet available. In the frame of the present project, we have made some experimental estimations to measure the multifactor productivity in inpatient health care.

The limited availability of data sources has impeded us to compile a conceptually correct measure. Our productivity index is a hybrid in the sense that the volume index of the gross output is compared to the indices of primary inputs. As the output is a gross value measure including intermediate consumption, in principle, factor inputs should have been measured also on a gross basis. Since there is no annual data collection for intermediate consumption of inpatient care, neither estimates could be compiled for the value added of such care nor was it possible to consider intermediate consumption as a factor input. For instance, the positive effect of the advances in the pharmaceutical industry was not accounted as increase of inputs, instead, it was captured by the productivity residual, causing an upward distortion.

Annual changes in output were estimated by the composite volume index of inpatient episodes financed by the NHIF, as presented in Chapter 2. The index of acute care was quality adjusted by hospital mortality rates and changes in the average length of hospital stay.

The capital input was estimated by the volume index of productive capital, as recommended in the OECD Manual on Capital Measurement. The stocks net assets were deflated to constant prices; the constant price indices by types of assets were aggregated, using depreciation and opportunity costs of capital as weights. Six-percent discount rate was used to calculate opportunity costs;[3] and chain Laspeyres indices were calculated.

In the period 2001–2009, capital input in inpatient care increased slightly at an annual rate of 0.9%.

Labour input is the weighted average of the quantity indices for the three groups of the employed (medical doctors, other medical professionals and auxiliary

[3] This corresponds to the average real interest rate of the National Bank of Hungary for the period 2001–2009. The nominal rate was divided by the rate of inflation. The latter was estimated by means of the consumer-price index of manufactured goods.

workers), weighted by the share of the sum of wages. During 2004–2009, the labour input declined considerably, in six years altogether by 18%.

Table 11

Elementary volume indices of capital goods by types of assets
(previous year = 1)

Year	Other building	Transport equipment	Machinery	Other
2009/2008	1.0037	0.9678	0.9804	0.9619
2008/2007	1.0156	1.0542	1.0028	1.5237
2007/2006	1.0330	1.0315	0.9905	0.9714
2006/2005	1.0352	1.0194	1.0011	0.9300
2005/2004	1.0350	1.0374	0.9892	1.3190
2004/2003	1.0294	1.0188	0.9928	1.2413
2003/2002	1.0188	1.0473	0.9979	1.1783
2002/2001	1.0513	1.1835	1.0380	1.2940
2009/2001	**1.2441**	**1.4054**	**0.9917**	**3.3050**

Source: Calculations based on national accounts and data compiled by the Hungarian Central Statistical Office (HCSO).

Table 12

Annual multi-factor productivity growth in inpatient health care, 2003–2009
(previous year = 1)

Year	Output volume index	Labour input	Capital input	Multifactor productivity
2004/2003	1.0126	0.9447	1.0134	1.0582
2005/2004	1.0421	1.0212	1.0143	1.0216
2006/2005	1.0038	0.9584	1.0070	1.0392
2007/2006	0.9147	0.9569	1.0019	0.9491
2008/2007	1.0438	0.9568	1.0154	1.0809
2009/2008	1.0090	0.9703	0.9930	1.0360
2009/2003	**1.0203**	**0.8214**	**1.0457**	**1.1941**

Source: Calculations based on HCSO and NHIF data.

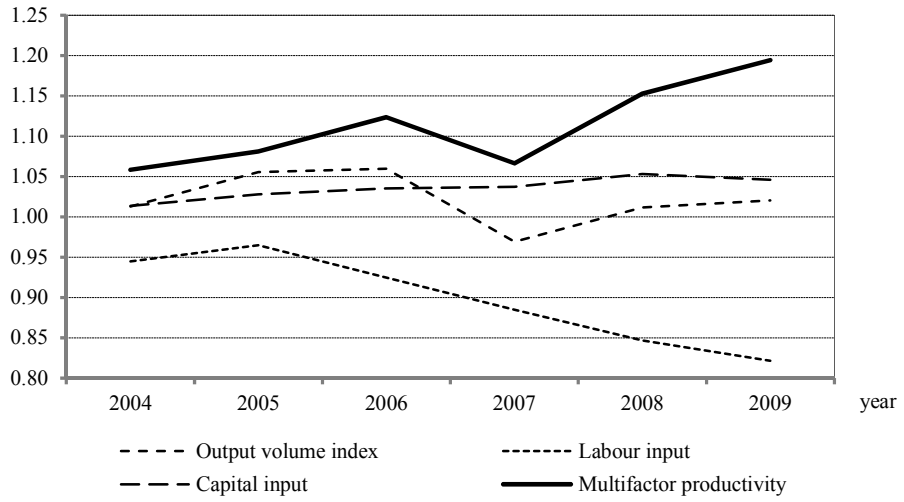
To aggregate capital and labour inputs, the factor input remuneration shares compiled in national accounts for health and social work were applied. Since in

Hungary health and social work services are rendered predominantly as non-market services, the value of the operating surplus includes mainly depreciation. The profit (net operating surplus) is not recorded. However, this is not consistent with the positive discount rate that was used to estimate opportunity costs.

A zero discount rate increases capital input by an annual rate of 0.1%. (If the discount rate is zero, the quantity indices by types of assets are aggregated using exclusively depreciation as weights. This gives greater importance to machinery and equipment, the share of which is growing in the stocks of assets of inpatient care.)

According to Figure 2, productivity in inpatient care has increased by about 20% from 2004 to 2009, which was primarily due to the decline in labour input. In the longer run, the 0.7% annual increase of the capital input cannot substitute the lack of skilled labour, and thus, this path of productivity growth is hardly sustainable.

Figure 2. Inpatient care productivity, 2004–2009
(2003 = 1)



4. Conclusion

The Hungarian case study demonstrates that quantity volume indices of inpatient health care can be estimated using administrative sources. In measuring productivity, there are also promising opportunities. The statistical service collects data on labour and investments at institutional level; thus in the future one can get access to data on

capital and labour input in sufficient detail. Data on intermediate consumption are collected in the same way.

Nevertheless, our potentials are much more limited in preparing quality-adjusted output volume figures. It is not obvious how data (available regularly, in sufficient detail) influence the quality of services. Therefore, they could be used as quality parameters only in that case, if surveys and interviews to be conducted occasionally with health care specialists would support the assumptions about the ways of their influence.

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